

BEEKEEPING AS A FACTOR OF DANUBE REGION SUSTAINABLE DEVELOPMENT¹

Bojana Bekić², Marijana Jovanović³

Abstract

Beekeeping is one of the most important activities in agricultural production due to the role of honey bees in pollination of agricultural crops. Pollination of crops, but also wild flora, is an ecosystem service provided mainly by honey bees and it is absolutely necessary for maintenance of ecosystem functioning. Besides importance of honey bees in producing quality crops, bees also create honey surpluses which are harvested and can be used as food or for some other purposes by humans. Beekeeping is one of the rare production activities that do not have any negative effect of quality of the environment and actually, this activity enables sustainable development of every natural area. Main goal of this paper will be to analyze, using existing data published in relevant publications, state and possible paths of beekeeping development in the Danube Region, in Serbia. Also, author will research the role of beekeeping activity in reference to three main principles of the sustainable development of Danube region: ecological, social and economical sustainable development.

Key words: *beekeeping, sustainable development, apiary products, pollination*

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²Bojana Bekić, Research Assistant, Institute of Agricultural Economics, Volgina 15 Street, 11060 Belgrade, email: bojana_b@iep.bg.ac.rs

³Marijana Jovanović, Research Assistant, Institute of Agricultural Economics, Volgina 15 Street, 11060 Belgrade, email: marijana_j@iep.bg.ac.rs

Introduction

Honey bee (*Apis mellifera* L.) is an insect which has a key role in maintenance of semi-autonomous and natural ecosystems in the world. Honey bees pollinate about 80% of spontaneous wild flora and over 85% of all agricultural crops. In European Union, beekeeping is considered to be one of the most important sectors of agriculture, with annual economic benefit from pollination of about 14.2×10^9 EUR (De la Rua et al., 2009). In many economically developed countries in the world, beekeeping is a developed branch of agricultural production sector, not just due to pollination services but also from production of honey bee products, mainly honey. Interest for beekeeping in EU and other countries in the world is increasing due to many factors: popularization of bees' importance in nature protection and preservation (i.e. growth of ecological awareness), the fact that this is an activity which can create additional income, it can be a safe haven for unemployed people or from the desire to produce and consume healthy and natural beekeeping products.

Also, increased interest for this production lies in the fact that it has a potential for further development without application of complex and expensive technologies or skills (Hilmi et al, 2011). However, due to environmental degradation for the past several decades, honey bees are subjected to great pressure of many negative environmental factors of which the most important are: environmental pollution by pesticides, intensive agriculture, biodiversity loss, poor natural nutrition, genetically modified organisms, inadequate apiary management and so on. Since 2006, beekeepers in the EU and the USA reported huge losses of honey bee colonies at their apiaries, which potentially endanger, before all, the service of pollination and thus production of enough quantities of food for human and animal nutrition. The cause of deaths is explaining by many factors such as: bee diseases (varoa, nosema etc.), genetically modified crops, decreased gene pool due to artificial insemination of queen bees, agricultural plant protection chemicals, poor bee nutrition and yet unknown biological factors. According to VanEngelsdorp et al. (2009), deaths are caused by synergetic effect of more factors rather than the effect of just one environmental factor. This indicates to the high rate of ecosystems degradation at global level, and necessity to apply clean and safe technologies in food production. Strategies for honey bees' preservation include minimizing or, when possible, eliminating listed negative factors and larger involvement of people in beekeeping.

One of main pillars of sustainable development is increased ecological awareness and nature protection. In agriculture, this considers application of ecologically safe and un-polluting materials and activities in all stages of food production. Beekeeping is an activity which perfectly corresponds to this requirement but, it also generates solid income, which gives a positive economical and social dimension to this production. In Danube region, development of beekeeping through larger involvement of people in this activity, could increase life standard of present population, especially in rural areas, and could enable maintenance of rich plants' and ecosystems' biodiversity. In such way, development of beekeeping would enable sustainable ecological, social and economical growth of this region.

Material and methods

The basic research method used in this paper was Desk Research Method. The aim of desk research was to identify and analyze existing hard copy and online sources on the state of beekeeping in Danube region and, based on that, to give possible paths for further beekeeping development. Main idea for this topic rose from the fact that honey bees, considering their role in ecosystems and food production, can enable and facilitate sustainable development of Danube region, respecting all three sustainability principles: social, economical and ecological development. In this paper, the role of honey bees and beekeeping in respecting and fulfillment of all three sustainability aspects will be elaborated.

Beekeeping in Serbia and Danube region – current state

In Serbia, longstanding tradition of beekeeping which dates back to the middle ages, and a good state of natural resources, especially vegetation and biodiversity richness, provide an excellent basis for development of beekeeping. According to Zarić et al. (2013), about 60% of beekeepers in Serbia have approximately twenty bee colonies and about 3% of beekeepers can be considered as professional beekeepers with over hundred bee colonies. Beekeepers sell their products, mainly honey, directly to buyers, where products' price is lower in compare to prices of apiary products in EU countries. Annual production of honey in Serbia is about 5 thousand tons and it is mostly presented by linden honey, acacia and sunflower honey. About 10% of total quantities of honey is produced in Vojvodina while the rest is produced in other parts of Serbia (Zarić et

al., 2013). Exact number of beekeepers in Serbia today is not known but estimations are that there is about 30 000 of them of which about 10 000 are members of the Beekeeping Association of Serbia (SPOSA). Based on Agricultural Census 2012, total number of bee hives in Serbia is about 665 000, of which the largest number is located in the region of Šumadija and Western Serbia. In the Danube region, exact number of bee hives is 104 384, which makes 15.69% of total bee hives number in Serbia. In Danube region, the highest number of hives is in the City of Belgrade, Negotin and Sombor while the lowest number is in Sremski Karlovci, Irig and Stara Pazova (Table 1).

Table 1. *Number of hives, associations of beekeepers and number of associations' members*

Municipality	Number of hives*	Number of beekeeping associations ¹	Number of associations' members**
<i>Upper Danube region</i>			
Sombor	7.672	2	71
Apatin	2.502	1	49
Bač	2.165	1	27
Bačka Palanka	3.949	1	23
<i>Middle Danube region</i>			
Grad Beograd	32.160	8	532
Grad Novi Sad	5.356	1	194
Beočin	2.090	-	-
Irig	967	1	8
Sremski Karlovci	434	2	19
Indija	2.917	1	39
Ruma	3.533	2	35
Pećinci	2.157	-	-
Stara Pazova	2.035	2	38
Pančevo	3.440	2	97
Smederevo	5.324	1	124
<i>Lower Danube region</i>			
Golubac	4.679	2	131
Kučevo	5.389	1	66
Majdanpek	2.278	2	35
Kladovo	3.012	2	52
Negotin	12.328	1	137
Total – Region Podunavlja	104.384	33	1684

Source: Agriculture Census 2012, <http://spos.info/broj-clanova-u-drustvima-i-udruzenjima-spos-a/>

Note: *Agricultural Census 2012, ** members which are at the same time members of beekeeping associations and members of SPOS (real number of beekeepers is higher)

¹ <http://spos.info/spos/clanstvo/drustva-i-udruzenja-pcelara/>

Number of beekeeping associations and societies in Serbia is 217, of which 33 are present in Danube region, which is 15% of total number of associations and societies in Serbia. Most municipalities in Danube region have one or two beekeeping societies or associations except City of Belgrade which has 17 municipalities and therefore there is a need for higher number of beekeeping societies and associations (Table 2).

Table 2. *Beekeepers' associations and societies in the Danube region*

Municipality	Number of beekeeping association ¹	Name of the beekeeping association
<i>Upper Danube region</i>		
Sombor	2	Association of beekeepers „Avram Maksimović“, BS „Pčela“
Apatin	1	BS „Dunav“
Bač	1	Association of beekeepers „Mostonga“
Bačka Palanka	1	Association of beekeepers „Pčela“
<i>Middle Danube region</i>		
City of Belgrade	8	Belgrade Association of beekeepers Association of beekeepers „Budućnost“, BS „Kosmaj“, BS „Obrenovac“, BS „Barajevo“, Association of beekeepers „Grocka“, Association of beekeepers „Ripanj“, Association for apitherapy and improvement of integrative protection
City of Novi Sad	1	BS „Jovan Živanović“
Beočin	-	-
Irig	1	BS „Irig“
Sremski Karlovci	2	BS „Stražilovo“, BS „Jovan Živanović“
Indija	1	Association of beekeepers „Roj“
Ruma	2	BS „Nikola Mileusnić“
Pećinci	-	-
Stara Pazova	2	Association of beekeepers „Polen“ BS „Jedinstvo“
Pančevo	2	BS „Podružnica“, BS „Starčevo“
Smederevo	1	BS „Smederevo“
<i>Lower Danube region</i>		
Golubac	2	BS „opština Veliko Gradište i Golubac“ BS „Golubački grad“
Kučevo	1	Association of Homolje beekeepers „Pek“
Majdanpek	2	BS „Poreč“, Association of beekeepers „Deli Jovan“
Kladovo	2	BS „Kladovo“ Association of beekeepers „Đerdap“
Negotin	1	BS „Hajduk Veljko“
Total	33	-

Source: <http://spos.info/spos/clanstvo/drustva-i-udruzenja-pcelara/>

¹ <http://www.spov.info/clanstvo/drustva-i-udruzenja-pcelara/>,
<http://spos.info/spos/clanstvo/drustva-i-udruzenja-pcelara/>

Number of beekeepers beekeeping associations and societies in Danube region, which are at the same time member of the SPOS-a, is 1 684 people but it is important to emphasize that this is not the final number of beekeepers in this region, due to the fact that not all beekeepers are member of SPOS-a or even a member of any beekeeping association or society in the region. Nevertheless, according to data found, the largest number of beekeepers is present in City of Belgrade, Negotin and Sombor (Table 2).

Diversification of beekeeping activities

Beekeeping is an activity mainly conducted in rural areas which are sparsely populated, due to special nature of beekeeping, and this is especially true in the case of high number of bee hives. In these areas, beekeeping is, and could be, an important income source for rural population. Generally, major characteristics of rural areas in Serbia and rural agriculture is the following: traditional mono-functional agriculture, agricultural production as main or only source of income, majority of the population engaged in agricultural production, problems in accessing the markets, lack of other work places, decreased possibility for employment other than agriculture, low density of population (Bogdanov, 2011). Development of beekeeping in such areas could increase living standard of rural inhabitants and potentially stimulate development or growth of other sectors of agricultural or agro-food production such as fruit or vegetable growing and processing. Some of the possible ways to increase income from beekeeping could be either increase of number of existing bee hives or diversification of production.

One of the ways to develop beekeeping is through so called diversification of beekeeping activities. That considers production of larger number of beekeeping products or offering of unique beekeeping service to potential tourists. According to Škrbić et al (2010), diversification of production and services represents the right way of entrepreneurship development and economical strengthening of rural households. Diversified agriculture based on knowledge opens the possibilities for development of industry, transport, storage, trade, services and other sectors of economy in rural areas (Ristić, 2013). Diversification of beekeeping enables creation of profit with smaller number of bee colonies which potentially causes better management of the apiary and production of more quality products (Shiffer, 2014).

Competitive advantage of diversified production lies in larger offer of products and services which represent unique combination of traits specific for each family farm, which makes it different in compare to the competition (Popovici et al., 2014). In which direction the diversification will take place is on each husbandry to decide, in accordance with their natural and human resources. Some of the possibilities for diversification of beekeeping at apiaries is the following:

- a) *Development of Api-tourism.* This is a new form of tourism which uses advantages of beekeeping as traditional production and variety of beekeeping products which can be studied from ecological, medicinal or gastronomical aspects (Wos, 2014). Leader in this form of tourism is Slovenia which has a long tradition in beekeeping (Šivic, 2013). Besides Slovenia, since 2004, some other countries in the world are trying to develop this form of tourism (Poland, Germany, the Czech Republic, Spain etc.). Api-tourism involves many activities such as visits to apiary, beekeeping museums, organizing bee routes, watching beekeeper at work with bees, extraction of honey, and observing life of bees. Also, it could include learning about melliferous plants, making of added value products at the apiary or tasting of beekeeping products or gastronomical delights.

There is also the health aspect of api-tourism which includes treatment of asthma by inhalation of air from the hive, application of bee venom in treatment of some diseases or massage with honey (apitherapy). Development of api-tourism is a possibility to activate rural areas, create new jobs and promote tradition and culture of rural areas, respecting regional differences. Rural tourism can create leaders for rural space development and to connect people outside the local community and discover new resources and activities which can be transformed into tourist products and services (Bilali et al, 2014). Certain examples of api-tourism already exist in Danube Region. For example, that is beekeeping museum in Sremski Karlovci in possession of family with long tradition in beekeeping.

- b) *Production of royal jelly.* Royal jelly is a highly priced product at the market for which there is high demand. It is a product of honey bees' special glands for the purpose of larvae and queen bee feeding. It is a creamy yellow substance which is used in human diet as a everyday supplement or during recovery from illness. It is also used as an

ingredient in cosmetic and pharmaceutical industry. It is sold and used fresh or dried (lyophilized). Price of royal jelly is determined based on content of water, proteins, dry matter and 10-hydroxy-2-decenoic acid (Bekić et al, 2013). To produce royal jelly beekeeper must not be a beginner but experienced beekeeper due to the fact that this production, if not performed well, can weaken the colonies. Official data regarding production of this and other bee products, other than honey, in Danube region do not exist.

- c) *Production of bee venom.* Bee venom is a product of special venom gland in bee workers with solely aim to protect the colony from intruders. Bee venom can be extracted from this gland by using specially designed devices which enable bees to be left unharmed. Bee venom is used for medical or cosmetic purposes (in production of gels, creams, balms, ointments, ampoules and masks with anti-age and anti-inflammatory effect). Raw bee venom at the market is in the form of powder, of various shades of yellow. Its price depends on its quality which is determined by concentration of mellitin substance in the venom. Concentration of mellitin depends on environmental conditions, bee race and method of venom collecting¹.
- d) *Production of propolis.* Propolis is resinous substance that honey bees collect from plants which has antibacterial properties. Bees use it for filling small cracks in the hive and disinfection and human can use it in cosmetics and medicine due to its healing properties (for production of creams, pills, toothpastes, shampoos, lip balms, facial masks, breath fresheners, chewing gums and sweeteners). Namely, in traditional medicine it is used for treatment of various skin damages such as burns, irritation, ulcers, blisters, psoriasis, sore throat, toothache etc.). Propolis is sold in raw state (chunks or powder) and as alcohol extract.
- e) *Production of value added products from wax.* Bee wax is a product of special worker bee glands and it is essential for building the colony. It is highly wanted product at the market due to the fact that it is used for various industries. Beekeeper can increase its farm income by making wax candles, cosmetics or wax foundations for his own bee colonies.

¹ <http://beevenomlab.biz/bee-venom/>

- f) *Production of melliferous plants.* Bee products offered at the market often contain plant ingredients such as essential oils or dried parts of plants. For the purpose of making beauty products it could be useful for beekeeper to grow some medicinal or aromatic plants. Plants chosen by beekeeper may include some economically important plants or plants characteristic for the rural area in which beekeeper lives. It's better to choose perennial plants which can be used for few years instead of annual plants. Such plant species could be sage, thyme, lavender, hyssop or lemon balm (Bekić et al, 2014).
- g) *Collection of pollen.* Bees collect pollen for feeding bee brood because it is the main protein source necessary for bees to fully develop. Pollen is used fresh or in dry form as a supplement in human nutrition because it is a rich source of enzymes, vitamins and minerals.

These are some possible paths to development of beekeeping through diversification of production and services. However, for accomplishment of some of the listed proposals certain preconditions must be fulfilled. For example, for development of api-tourism in a rural area, at least basic infrastructure must exist. That is something on which producer has little influence on and which must be dealt at state level. For value added products from beekeeping, marketing of products must be well designed and market secured. This might be a problem for a producer in rural areas, further away from large cities. Nevertheless, through surpassing of these obstacles, diversification could be a possible way to sustainable economical, social and ecological development of rural areas in Danube region.

Organic beekeeping – a chance in protected areas

Modern conventional agricultural production is characterized by large use of plant protection chemicals whose production and application is increasing. Some of these chemicals are toxic for bees and lead to chronic or acute intoxication of bees. The most dangerous are neonicotinoides which hold over 25% of world market of insecticides (Bekić et al, 2015). It is scientifically proven that these pesticides have lethal or sub-lethal impact on development of bee brood, that they disable orientation of bees during flight return to the hive because they affect memory and learning of bees. Therefore, it is out of most importance to educate crop producers which chemicals to use and in which way. Many agricultural producers do not understand the role of bees in pollination of crops and the benefits achieved

therefore. In Danube region, there are large areas under agricultural crops pollinated by bees, such as sunflower and rapeseed, thus understanding and cooperation between beekeepers and producers of agricultural crops is fundamental and urgent (Bekić and Roljević, 2013). Especial problem related to these chemicals is their accumulation in the environment including bodies of living organisms and their products. Also, besides neonicotinoides there are other agricultural chemicals toxic for bees such as organophosphorous insecticides, organohlorine insecticides, piretroides etc. Most of these insecticides impact honey bees' nervous system. Neonicotinoides, fluvalinat and fopronil are possibly among factors which cause Colony Collapse Disorder, which is, since it appearance in 2006, spread to many European countries and USA. Official data about existence of this phenomenon in Serbia does not exist. Because of these scientific findings, EU Commission has banned use of neonicotinoides in agricultural production till the end of 2015, when this decision will be revised¹. This problem is widely spread and very serious, both from economic point of view (beekeeping is an industry worth billions in some countries) and from ecological point of view (pollination and food production).

From all these reasons, and more, some other methods of agriculture production emerged at the surface. One of the most recognizable is method of organic agriculture production which is a guarantee of products' and environmental' safety. It can be applied both in plant and animal production and therefore beekeeping too. The main rules of organic beekeeping include (Bekić et al, 2011):

- Conversion period of bee colonies of at least of one year
- Beekeeper must use only organically produced wax
- Local types of honey bees have advantage over other types and races
- All purchased swarms must be from apiaries with organic method applied in the production
- All food for bees must be from organic production
- Artificial additives in beekeeping products are not allowed
- Treatment against varroa includes application of organic acids, essential oils and biological methods of control
- Hives must be made of wood and painted with organic colors
- Disinfection of hives is done by physical treatment (heat, mechanical cleaning and if necessary sodium hydroxide)
- As in conventional beekeeping all activities at the apiary must be well documented.

¹ http://ec.europa.eu/food/animals/live_animals/bees/health/index_en.htm

When talking about conversion period it should be noticed that transition from conventional to organic beekeeping is probably easier than in the case of other agricultural branches.

Main issue in organic production is absence of polluters in surrounding of few km. All these requirements can be fulfilled in protected natural areas which exist in Danube region (Table 3).

Table 3. *Protected natural areas in the Danube region*

Name of protected area	Type of protection	Municipality	Area, ha
Fruška Gora	National Park	Beočin, Novi Sad, Sremski Karlovci, Bačka Palanka, Šid, Sremska Mitrovica, Indija, Irig	25.393
Đerdap	National Park	Golubac, Majdanpek, Kladovo	63.608
Begečka jama	Nature Park	Novi Sad	379
Ponjavica	Nature Park	Pančevo	134
Tikvara	Nature Park	Bačka Palanka	508
Jegrička	Nature Park	Bačka Palanka, Vrbas, Temerin, Žabalj	1.145
Koviljsko petrovaradinski rit	Special Nature Reserves	Novi Sad, Sremski Karlovci, Indija, Titel	5.895,3
Gornje podunavlje	Special Nature Reserves	Apatin, Sombor	19.648
Obedska bara	Special Nature Reserves	Pećinci, Ruma	9.820
Bagremara	Special Nature Reserves	Bačka Palanka	118
Kosmaj	Landscape of extraordinary characteristics	Beograd, Mladenovac	3.515
Avala	Landscape of extraordinary characteristics	Beograd, Voždovac	489
Total – Danube Region	13	-	130.652,3

Source: <http://biodiverzitet-chm.rs/biodiverzitet-u-srbiji/zastita-biodiverziteta/zasticena-podrucja/lista-zasticenih-podrucja-republike-srbije.pdf>

In Danube region there are two National Parks, four Nature Parks, four Special Nature Reserves and two Landscapes of Extraordinary Characteristics, which cover total area of 130 652,3 ha. These areas have special flora and fauna, many endemic and relict endangered species, and therefore are out of most importance for protection and preservation. Preservation of these areas is naturally related to organic beekeeping methods. Benefits achieved by this practice would be both for a beekeeper (profit achieved from organically produced products) and for nature and human society in general (from production of safe and healthy products and service of plant pollination). In European Union, there is a strong need for organic honey, especially monofloral honey. In Serbia, almost all honey produced is from conventional beekeeping although there are good natural conditions for organic beekeeping, especially in protected areas. This can be a good chance for beekeepers in Danube region, to add value to their production and profit more from their beekeeping practice.

Certification of beekeeping products

Adding value to beekeeping products has various meanings, from products with added natural ingredients to special ways of products' marketing. However, obtaining some specific certificate could also be a way to add value to the product, and thus increase its final price. Reason for creation of value added products is obvious, and it can be found in the following: more competitive surrounding, chance to be distinguished from the large number of similar products at the market, chance to earn bigger profit, boosting of innovation etc. Beekeeper can certificate for example, *organic production* where that makes him different in compare to the other producers of similar products, which do not apply organic methods of production. But, what can distinguish a beekeeper from other producers at the market is also certification of *products' authenticity*. Honey authenticity can be observed from the aspect of production process authenticity and authenticity of botanical and thus geographical origin (Bogdanov and Martin, 2002). Production process refers to method of honey extraction and potential changing of its composition during production process or after complete extraction. Due to many affairs in the past years linked to food production, large significant nowadays is given to researches whose aim is to prove geographical origin and authenticity of products used for human nutrition, which includes also beekeeping products, mostly honey. Namely, authenticity of beekeeping products can be proven by certain laboratory methods which can confirm

the method of production and the geographical origin of the product. If that geographical area is known to be with preserved environment and traditional beekeeping practice than it is considered the added value to the product. It is believed that this product has higher quality and thus it has higher price at the market, in compare to other similar products. Products with PGI (protected geographical indication) and PDO (protected designation of origin), which are proof of products' authenticity, are very popular. In Europe, currently, there is over twenty different types of honey with protected PDO or PGI, mostly in Spain, France and Portugal¹. This honey does not contain any imported honey or any additives, and the certificate proves that. Certification enables capturing of market niches which are not under severe competition by large companies because it is related to productions which are limited by a certain geographical area.

Most honey in Serbia is sold at retail market or to wholesale purchasers without any indication of origin. However, in recent years there is a certification process of some honeys made in some areas. Certified honeys in Serbia include: Homolje honey, Linden honey from Fruška Gora and Kačer honey. There are no prescribed quotas for their export to European Union and at domestic and foreign market they achieve higher prices, in compare to similar products without such certificate². So, in the Danube region there are already some certified honeys by their geographical origin. There is a possibility to relate organic production with authenticity of geographical origin for the purpose of achieving even greater added value of honey. For example, in protected area NP Fruška Gora, beekeepers could be producing organic linden honey. Potentially, such product could be successfully sold at the market because it is monofloral and it is of proven quality. But, except the certificate, which is a guarantee of high quality and control, there must be enough quantities of these products for continual sale at the market, which can be achieved by enlargement of production and involvement of more people into beekeeping practice. Also, similar certification perhaps could be achieved in other protected areas in this region. In such way, certification could contribute to sustainable economical and social development of this region.

¹ https://en.wikipedia.org/wiki/Regional_honeys

² <http://www.kombeg.org.rs/Komora/udruzenja/UdruzenjePoljoprivredeKacerskiMed.aspx?veza=3404>

Conclusion

Beekeeping as an important main or additional source of income has becoming more and more attractive, especially in light of high unemployment rate of rural population and large possibilities for honey export. Also, very important fact is that beekeeping gives a certain extent of autonomy to producers, especially regarding organization of production but also regarding products' sale. Another significant factor which differ this production from other sectors of agricultural production is that main beekeeping product, honey, is a non-perishable product which can be stored for a long time. This gives the producer certain liberty in terms of finding a more favorable buyer or changing his business strategy, if conditions at the market are currently not favorable. For the purpose of beekeeping development in Danube region certain activities should be conducted: diversification of beekeeping, application of good beekeeping practice, quality control and authenticity of beekeeping products, education of fruit and crop producers regarding application of pesticides in agricultural production, establishment of cooperation and experience exchange among beekeeping associations, better marketing of bee products, planting of melliferous trees, beekeeping in protected areas (organic beekeeping), involvement into api-tourism etc. Application of all these activities can lead to sustainable social, economical and ecological development of entire Danube region.

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